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ABSTRACT

In 1991, a survey questionnaire concerning undergraduate education in physics was sent to a nationally representative sample of 597 four-year colleges and universities. Of these, 475 had an undergraduate physics department or a department with a physics program, and met the criteria for inclusion in the study. Responses were received from 450 of the 475 eligible institutions. The data were weighted to provide national estimates about instruction staff, computer resources, course offerings, and issues and concerns in undergraduate education in physics. Some of the highlighted results included the following. Three-quarters of 4-year colleges and universities had physics programs. Bachelor's degrees were offered by 79% of the departments with physics programs, 25% offered master's degrees, 17% offered doctorates, and 3% associate's degrees. Slightly over one-fourth of the departments stated that the number of students who declared a major in physics increased in the last 5 years. In evaluating the six components of undergraduate education in physics, department chairs assessed curriculum and faculty/staff resources more positively than they did student preparation and motivation. A large majority (85%) stated they offered undergraduate physics students access to departmental computers for undergraduate research and coursework. (PR)

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SURVEY ON UNDERGRADUATE EDUCATION IN PHYSICS

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Higher Education Surveys Report
Survey Number 15 - Physics
December 1992

A Survey System Sponsored by the National Science Foundation, the National Endowment for the Humanities, and the U.S. Department of Education

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SURVEY ON

UNDERGRADUATE EDUCATION IN PHYSICS

Sponsored by:

The National Science Foundation
Directorate for Social, Behavioral, and Economic Science
Division of Science Resources Studies

Written for:

The National Science Foundation
Directorate for Mathematical and Physical Sciences
Division of Physics

and

Directorate for Education and Human Resources
Division of Undergraduate Education

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Higher Education Surveys Report
Survey Number 15 - Physics
December 1992

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Other individuals at the National Science Foundation also contributed to the questionnaire design and presentation of survey results.

From Westat, Pat Cruz was the data preparation supervisor for the survey, and Debbie Alexander supervised the telephone followup. Mary Jo Nolin assisted with report preparation.

We also acknowledge the indispensable contribution of the many department chairs, faculty, and staff members at the sampled institutions who reviewed and completed the survey questionnaire.

Highlights

In spring 1991, a survey questionnaire of undergraduate education in physics was sent to a nationally representative sample of 597 four-year colleges and universities. Of these, 475 had an undergraduate physics department or a department with a physics program, and met the criteria for inclusion in the study. The remaining 122 institutions did not meet the criteria. Responses were received from 450 of the 475 eligible institutions. The data were weighted to provide national estimates about instructional staff, computer resources, course offerings, and issues and concerns in undergraduate education in physics.

- Three-quarters of the Nation's four-year colleges and universities had physics programs. Almost all research institutions (98 percent) and a large majority of doctoral (91 percent) and comprehensive (85 percent) institutions had departments with programs in physics; 57 percent of liberal arts colleges offered programs in physics.

- Bachelor's degrees in physics were offered by 79 percent of the departments with programs in physics; 25 percent offered master's degrees, 17 percent offered doctorates, and 3 percent, associate's degrees.

- Slightly over one-fourth of the chairs of departments with physics programs (26 percent) stated that the number of students who declared a major in physics had increased in the last five years. The majority (57 percent) indicated that the number of majors had stayed about the same, and 17 percent indicated that the number had decreased.

- When evaluating six components of undergraduate education in physics, department chairs assessed curriculum and faculty/staff resources more positively than they did student preparation and motivation.

- The academic preparation of entering freshmen was ranked as the most important issue of concern to chairs of departments with physics programs. Other issues ranking as major concerns were the amount and quality of instructional laboratory equipment and facilities, and student interest and motivation.

- A large majority (85 percent) of chairs of departments with physics programs stated that their department offered undergraduate physics students access to departmental computers for undergraduate research and coursework. Nine out of ten of the chairs (92 percent) stated that their students had access to campus-wide computer resources for undergraduate research and coursework.

- In fall 1990, an estimated 11,570 undergraduate and 2,360 graduate courses were offered by the estimated 1,024 four-year colleges and universities with physics programs. An average of 11.3 undergraduate physics courses and an average of 8.5 graduate physics courses were taught in each program offering courses at those levels.

- An estimated 6,500 full-time and 950 part-time faculty taught physics courses to undergraduates in fall 1990. This represented 84 percent of all full-time and 93 percent of all part-time instructional physics staff.

- Of the full-time faculty teaching physics to undergraduates, a majority, 53 percent, were full professors, 22 percent were associate professors, 21 percent were assistant professors, and 4 percent were lecturers or instructors.

- The average (mean) number of faculty in each program teaching physics to undergraduates was 6.3 full-time and 0.9 part-time faculty. The average full-time faculty included 3.4 full professors, 1.4 associate professors, and 1.3 assistant professors.

- A large majority (92 percent) of full-time faculty teaching physics to undergraduates held doctorate degrees, and 8 percent had master's degrees.

- Males constituted 94 percent and females 6 percent of the full-time faculty members who taught physics to undergraduates in fall 1990. Part-time faculty teaching physics to undergraduates were 85 percent male and 15 percent female.

- The full-time faculty members who taught physics to undergraduates in fall 1990 were 86 percent white, non-Hispanic, and 8 percent Asian. The remaining 6 percent were split evenly among Hispanics; black, non-Hispanics; and nonresident aliens.

- An average of 85 percent of the instructional contact hours for undergraduate physics was taught by full-time faculty. "Contact hours" includes lectures, laboratories, and discussion groups. Teaching assistants provided 8 percent of the undergraduate contact hours and part-time faculty provided 7 percent.

- Forty-one percent of the chairs of departments with physics programs stated that their department had teaching assistants (TAs). All chairs of departments at research institutions and 92 percent of those at doctoral institutions indicated their department had TAs.

- Approximately 80 percent of the chairs of departments that had TAs indicated that TAs in their department grade tests and papers and conduct laboratory sections; 60 and 45 percent, respectively, indicated TAs hold office hours and conduct discussion groups.

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Introduction

This survey of physics programs at the Nation's colleges and universities represents one of the first efforts of the National Science Foundation (NSF) to gather information nationally on a number of topics in undergraduate science and engineering education. In the past, NSF has collected data on graduate education and has used, when necessary, existing data on undergraduate education collected by other Federal agencies and professional associations. However, in the last several years, NSF's budget for undergraduate education has increased substantially, and programs are being developed to improve the proficiency of all students in science and mathematics. In order to develop new undergraduate education programs and evaluate existing ones, information on specific fields of science and engineering is needed.

This survey, and companion surveys of geology and sociology programs, are the first in a series of Higher Education Surveys of selected science and engineering departments that will capture information on undergraduate science and engineering in the Nation's universities, four-year colleges, and two-year colleges.[1] The data developed in these surveys will provide current information to planners and policy makers in education, government, and industry.

This survey of undergraduate programs in physics requested information on the organization of the department or program in which undergraduates take physics courses, characteristics of the instructional faculty who teach undergraduate physics courses, issues and concerns of the physics department chair (or chair of the department with a physics program), type of physics course offerings, and availability of computer resources to students enrolled in physics. The general purpose of the survey of undergraduate physics programs is two-fold. First, it provides baseline data on the characteristics of institutions, departments/programs, and faculty responsible for providing instruction to undergraduates in physics. Secondly, it allows NSF to determine the quality of available data, and the feasibility of collecting data on undergraduate education, other than earned degrees, by discipline.

The data were collected in spring 1991 from department chairs at a national sample of 597 four-year colleges and universities, representing a universe of approximately 1,370 four-year institutions (specialized institutions were excluded from the sample). The sample consisted of 104 research, 106 doctoral, 150 comprehensive, and 180 liberal arts institutions, and 57 historically black colleges and universities (HBCUs) that are not part of the HES panel.[2] Screening of institutions found 122 to be out of scope because they did not have an undergraduate program in physics. This resulted in

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[1]Similar surveys were conducted of undergraduate programs in physics, sociology, and geology. In addition, surveys on undergraduate instruction in electrical, mechanical, and civil engineering have been completed. Findings from these surveys are available in separate reports. Also, a survey of technical education in two-year institutions is scheduled to be conducted in winter 1992-93.

[2]See Appendix B for a brief description of the different types of institutions.

an in-scope sample of 475 institutions. Questionnaires were not received from 6 institutions, and 19 institutions refused to participate in the survey. The overall response rate was 95 percent based on 450 responses from the 475 institutions that met the criteria for inclusion in the survey. Appendix B provides a more detailed discussion of the sample and survey methodology. The survey questionnaire is reproduced in Appendix C.

Definition of Programs and Courses

One of the purposes of the survey was to determine how much undergraduate instruction in physics was being offered in the Nation's four-year colleges and universities, and characteristics of the faculty providing this instruction. To broaden the coverage of the survey to include institutions that did not have physics departments but taught courses in physics, a decision was made to survey "departments that offered programs in physics" instead of physics departments.[3] Thus, an important methodological issue in this study was defining the term "physics programs," since institutions defined their programs differently. Pretest results showed that the potential respondents, the department chairs, would know if they had an undergraduate program in physics. However, after mailout, it was discovered that some respondents needed clarification on what constituted a physics program, a physics course, and a separate program in other disciplines.

The instruction at the top of the questionnaire directed it to the attention of "the Chair of the Department of Physics, or the department that offers a program in physics." This instruction was insufficient for two reasons. First, if the institution did not have a department or degree with that name, the questionnaire sometimes was discarded as not applicable for the institution. For example, chairs of departments called Natural Sciences sometimes did not realize that they should complete the physics questionnaire. Second, chairs did not know what was meant by "program." Most chairs seemed to interpret this to mean "major." Thus, some chairs at institutions that offered a number of courses in physics but did not have a major in physics discarded the questionnaire as not applicable to them. These different interpretations of the instructions made clarification of them necessary. Additional instructions were provided (post-mailout) that stated that an institution was considered to have a physics program if it "offered a major or minor in physics, or taught four or more physics courses on a regular basis." However, defining what was meant by four courses also turned out to be problematic for physics. Many institutions offered two or three versions of their introductory physics courses (e.g., physics with calculus, physics without calculus, and physics for those who had not had physics in high school). Some department chairs considered this to be one course, since the versions were all introductory physics, while other chairs considered this to be three courses (or six semesters) of physics. It was decided that if a department offered only introductory physics, regardless of the number of versions of

[3]This decision was based on discussions with NSF and Westat staff, department chairs, and staff of professional associations.

the course taught, that the department would not be considered to have a physics program. Thus, for purposes of this report, an institution was considered to have a physics program if it offered a major or minor in physics, or offered four or more physics courses (including courses that were nonintroductory) on a regular basis. Given that programs are defined in this manner, figures presented in this report should not be interpreted as being estimates of the number of physics departments or the total number of faculty teaching physics in the country. Instead, these figures represent the number of physics programs in the country, some of which may not be located in physics departments, and the faculty who teach physics in these programs. As a result, there are fewer physics departments than there are programs, because physics programs may be housed in departments with names other than physics (e.g., physical sciences).

Clarification was also provided for determining whether specific physics courses in departments other than physics should be included in the study. For example, department chairs were not sure if "Introduction to Physical Sciences" should be considered a physics course. Chairs were asked to consider the course content in deciding whether such courses should be considered as physics courses.

To determine the organization of the department in which physics programs were housed, department chairs were asked if their department had a separate program for any discipline in addition to physics. During data collection, it became apparent that department chairs were not sure what was meant by a "separate program." Some were listing subareas of the discipline (e.g., biophysics) even if they did not offer a degree in those subareas, while others considered these subareas to be part of the target discipline. Chairs at some schools where physics was offered in a multidisciplinary department, such as a department of physical sciences, were listing diverse disciplines such as chemistry, geology, and mathematics as "separate programs." Chairs at other institutions that listed a department name as "physical sciences" indicated that they did not have any separate programs. Department chairs that called with questions were told that subareas of physics should be considered to be part of physics, not separate programs, and that diverse disciplines, such as mathematics and chemistry, should be separated from physics when completing the questionnaire if at all possible. Results showed that between 82 percent and 85 percent (depending on the question) of the department chairs responded for physics programs only, with the rest responding for physics plus other programs.

Section V of the questionnaire asked department chairs to give the number of "different undergraduate and graduate physics courses, as identified by course title or number" taught in their department. Respondents tended to differ in the way they counted laboratories and discussion groups that were affiliated with lecture courses. If a chair called to ask how these discussion groups and laboratories should be counted, they were told to consider them to be part of the lecture course. However, since this instruction was not explicitly put on the questionnaire, it is not known to what extent this was done by all respondents. Discussions with respondents and inspection of

microfiche college catalogs indicated that institutions differed in the way that course numbering for labs and discussion groups was handled. Some schools gave them the same course number as the lecture with which they were associated, and some gave them a different course number than the lecture. Some respondents also said that a student could enroll in a laboratory if he/she was not enrolled in the lecture portion of the course, although students rarely, if ever, actually did this. Results, therefore, reflect the institutions' definition of "course," which may or may not have included laboratories, discussions, or both.

Report Overview

Data in this report are presented as "total" figures, which represent all four-year colleges and universities grouped together, and by institutional control (public and private) and type (research, doctoral, comprehensive, and liberal arts). These classifications are defined in Appendix B (see page B-9). Unless otherwise specified, data reported in the text refer to "total" figures. While the total numbers are the major focus in the text, additional information by control and type are presented in the tables and figures.

The estimates in this report are based on sample data that have been weighted to produce national estimates.[4] Because these estimates are subject to sampling variability, numbers in the tables, figures, and text have been rounded. Percentages and averages have been calculated on the actual estimates rather than the rounded values. Specific statements of comparison made in the text are significant at the 95 percent confidence level or better.

Programs and Degrees

In spring 1991, an estimated 1,024 four-year colleges and universities had physics departments or departments with programs in physics.[5] About a third (33 percent) of physics programs were located in departments that offered separate programs in other disciplines in addition to physics (unpublished tabulation). The most frequently mentioned separate program was astronomy. Other disciplines mentioned frequently as separate programs (in addition to physics) were chemistry, geology, and engineering physics.

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[4]Nonresponse adjustment weights were also calculated. Weights were calculated based on (1) the original sample stratum of the institution, (2) whether or not the institution was an historically black college or university, and (3) its response status, i.e., respondent, ineligible, or nonrespondent.

[5]All departments offering programs in physics will be referred to as "departments with programs in physics" or "physics programs" for the remainder of the report.

In spring 1991, there were more undergraduate physics programs at private institutions than at public institutions; 57 percent of the 1,024 physics programs (580 programs) offering undergraduate instruction were located at private institutions, and 43 percent (444 programs) were located at public institutions. By type of institution, 49 percent (501 programs) were located at comprehensive institutions, 32 percent (325 programs) were located at liberal arts colleges, 10 percent (102 programs) were at research universities, and 9 percent (96 programs) were at doctoral institutions. The percentages of institutions with physics programs varied significantly by type, with the highest concentration among the research universities, and the lowest among the liberal arts colleges. As shown in Table 1, almost all research (98 percent) and most doctoral (91 percent) and comprehensive (85 percent) institutions had physics programs; only about half (57 percent) of liberal arts colleges had physics programs. Most (90 percent) public institutions had physics programs, compared to only two-thirds (66 percent) of private institutions.

Table 1. Number of institutions, and number and percentage of institutions with physics programs, by control and type of institution: United States

Institutional characteristic	Number of institutions[1]	Number of institutions with physics programs[2]	Percentage of institutions with physics programs
Total	1,368	1,024	75%
Control			
Public	495	444	90
Private	873	580	66
Type			
Research	104	102	98
Doctoral	106	96	91
Comprehensive	591	501	85
Liberal arts	567	325	57

[1]Represents all research, doctoral, comprehensive, and liberal arts colleges and universities in the United States.

[2]An institution was considered to have a physics program if it offered a major or minor in physics, or taught four or more physics courses on a regular basis.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Level of Degrees

The majority of departments with physics programs (79 percent) offered bachelor's degrees in physics (Table 2). However, only 25 percent of the programs awarded master's degrees, 17 percent awarded doctorate degrees, and 3 percent awarded associate's degrees. Physics programs at public institutions were more likely to award master's degrees and doctorates in physics than were physics programs at private institutions. Research and doctoral universities were more likely than comprehensive institutions, which in turn were more likely than liberal arts colleges, to award bachelor's, master's, and doctorate degrees in physics.

The level of training in physics available to students varied according to the type of institution at which the program was located. Students studying physics at research universities had the opportunity to pursue advanced training in physics -- 98 percent of the programs at research institutions offered master's degrees in physics and 97 percent offered doctorates (Table 2). Advanced study in physics was also available to a somewhat lesser extent in programs at doctoral institutions, where 83 percent of the physics programs offered master's degrees and 55 percent offered doctorates in physics. The pattern was different at comprehensive and liberal arts institutions; only 16 percent of the physics programs at comprehensive institutions awarded master's degrees, and only 4 percent awarded doctorates. At liberal arts colleges, less than 0.5 percent of the physics programs awarded master's degrees, and none awarded doctorates in physics.

Table 2. Percentage of departments with physics programs conferring degrees at each level, by control and type of institution: United States

Level of physics degrees	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Associate's	3	2	3	1	0	1	6
Bachelor's	79	83	75	100	99	79	65
Master's	25	40	14	98	83	16	*
Doctorate	17	25	10	97	55	4	0

* = less than 0.5 percent.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Physics Majors

Chairs of departments with programs in physics were asked to indicate whether they perceived the number of students who declared a major in physics to have increased, stayed about the same, or decreased over the last five years. Over half of the respondents (57 percent) indicated that the number of majors had stayed about the same, 26 percent said the number had increased, and 17 percent indicated that the number had decreased (Table 3). There was little variation in the perception of change in the number of majors by institutional control or type.

Issues and Concerns in Undergraduate Education

The chairs of departments with physics programs were surveyed on selected aspects of six components of undergraduate education. Department chairs rated student preparation and motivation, curriculum, laboratory equipment for undergraduate instruction, facilities for undergraduate instruction, faculty and staff resources, and teaching assistants on a scale of very poor to very good (Appendix Table A-1).[6] Overall, curriculum and faculty/staff resources received favorable evaluations. Student preparation and motivation received the least positive assessments. In addition, there was substantial variability on most issues among programs at different types of institutions. In addition to the ratings, respondents ranked the top five problematical issues in order of their severity.

Table 3. Percentage of chairs of departments with physics programs indicating that the number of students who declared a major in physics over the last 5 years has increased, stayed about the same, or decreased, by control and type of institution: United States

Change in number of majors	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Increased	26	31	23	27	32	26	25
Stayed about the same. . . .	57	57	56	60	52	55	59
Decreased	17	12	21	13	16	19	16

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

[6] As shown in item 4 on the questionnaire in Appendix C, each category included more than one item. Respondents were asked to rate each item on a 5-point scale from very poor to very good. The analysis reported here is based on that scale collapsed into 3 categories, *poor*, *average*, and *good*.

Ratings of Aspects of Undergraduate Education

Most chairs of departments with physics programs indicated that entering freshmen had average or poor academic preparation, and that students had average or poor interest and motivation, and computer background. About one-third of the respondents rated the academic preparation of entering freshmen as poor, 48 percent judged it to be average, and only 18 percent reported it to be good (Appendix Table A-1). Chairs at different types of institutions differed on this measure, however, with respondents at research institutions (30 percent) more likely than those at doctoral (13 percent) or comprehensive (12 percent) institutions to rate the academic preparation of their freshmen as good. There was no significant difference between the responses of chairs at research universities and those at liberal arts colleges on this item. Evaluation of the computer background of students was comparable. Students in 35 percent of the programs had a poor background in computers, in 50 percent, an average background, and in 16 percent, a good background. The interest and motivation of physics students was rated somewhat more positively; 36 percent of the chairs judged it to be good, 47 percent average, and 17 percent rated it as poor. There were differences among programs on these measures as well. Department chairs at research institutions evaluated their students more highly on computer background and interest and motivation than did chairs at other types of institutions. Twenty-eight percent of the chairs at research institutions rated the computer background of physics students as good versus 16 percent at comprehensive, 20 percent at doctoral, and 10 percent at liberal arts institutions. Fifty-three percent of chairs at research institutions rated the interest and motivation of their students as good, but chairs at only 30 percent of comprehensive, 34 percent of doctoral, and 41 percent of liberal arts institutions did so.

A substantial majority of chairs gave a good rating to curricular aspects of undergraduate physics education. Three-quarters of the respondents rated their introductory texts as good, and 86 percent gave that rating to advanced textbooks, while 60 percent of the department chairs reported good opportunity for their students to engage in undergraduate research through independent study or advanced coursework. Chairs at comprehensive (80 percent) and doctoral (83 percent) institutions were more likely than those at liberal arts (67 percent) or research (66 percent) institutions to evaluate their introductory texts highly. Chairs at research (84 percent) and doctoral (75 percent) institutions were more likely than those at comprehensive (53 percent) and liberal arts (57 percent) institutions to judge that their students had good opportunity for undergraduate research through independent study or advanced coursework.

Evaluation of laboratory equipment and facilities for undergraduate education, while better than the evaluation of some student characteristics, was not very positive overall. The quality of instructional laboratory equipment was rated good by only one-third of the physics chairs, and 31 percent reported that their equipment is poor. Similarly, only about one-quarter indicated that they have an amount of instructional laboratory equipment which they

characterize as good, and 44 percent reported the amount of laboratory equipment as poor. The evaluation of laboratory facilities for undergraduate instruction was somewhat more positive. About 46 percent of the chairs reported that they have good quality laboratory space for instructing students, and 42 percent said they have a good amount of laboratory space. However, only 25 percent of the department chairs reported having demonstration lecture facilities that are good.

In general, chairs at research institutions reported better laboratory equipment and facilities for undergraduate instruction than did chairs at other types of institutions. For instance, 39 percent of chairs at research institutions rated their amount of laboratory equipment as good, while about 25 percent of chairs at comprehensive, doctoral, and liberal arts institutions did so. The situation was similar with regard to the rating of the quality of laboratory space and the demonstration capabilities of lecture facilities. However, chairs at liberal arts colleges (52 percent), as well as those at research universities (46 percent), were more likely than chairs at doctoral (33 percent) and comprehensive (36 percent) institutions to rate the amount of laboratory space available for undergraduate education as good.

Faculty and staff resources received good ratings from the majority of department chairs. For example, 69 percent rated introductory class size as good, and 85 percent cited advanced class size as good. About 60 percent of the chairs reported good recruitment and retention of qualified faculty. Finally, three-quarters of the chairs evaluated highly (i.e., rated as good) the language ability of faculty members whose first language is not English. More chairs at liberal arts institutions (82 percent) gave a good rating to the size of their introductory classes than did those at comprehensive (72 percent), doctoral (47 percent), or research (37 percent) institutions.

Teaching assistants were not used in all physics programs; 59 percent of the programs did not have teaching assistants in the fall of 1990. (The use of teaching assistants is discussed in more detail later in the report.) The presence of teaching assistants varied by institutional type. For example, all of the chairs at research institutions and 92 percent of the chairs at doctoral institutions indicated they had teaching assistants in the fall of 1990, but only 25 percent of chairs at comprehensive institutions and 33 percent of those at liberal arts institutions did. For the chairs that did complete the ratings for teaching assistants, the availability of teaching assistants was rated as good by 48 percent (Appendix Table A-1). The quality of teaching assistants was rated as good by slightly more than half of all chairs of departments with physics programs. The language ability of the teaching assistants whose first language is not English received a lower rating; only 20 percent rated it as good. This rating differs considerably from that for faculty whose first language is not English, with 75 percent of chairs rating faculty language abilities as good.

Greatest Problems for Undergraduate Education

Survey respondents were asked to select the five most critical problems for undergraduate education in physics from among the educational items that they rated and to rank these five problems according to their severity. The academic preparation of entering freshmen emerged as the greatest concern. Nearly one-third of the chairs cited it as their greatest problem (unpublished tabulation), and 44 percent ranked it as one of the three most critical problems for undergraduate education in physics (Figure 1).

Laboratory facilities and equipment emerged as the other significant issue for physics programs. The amount of instructional laboratory equipment available to physics programs was judged to be the greatest problem by 11 percent of the chairs, and it was ranked in the top three problems by 38 percent. Ten percent of the chairs ranked the quality of laboratory equipment available for instructing undergraduates as their greatest problem, and 7 percent gave that ranking to the amount of their laboratory space. Retention and recruitment of qualified faculty (ranked first by 5 percent of physics chairs) and student interest and motivation (ranked first by 6 percent) were also among the most frequently mentioned as the most significant problem for undergraduate education in physics. The same issues, as well as the quality of laboratory space and the demonstration capabilities of lecture facilities, were ranked among the three greatest problems facing undergraduate education in physics by 12 percent or more of the department chairs.

Computer Resources

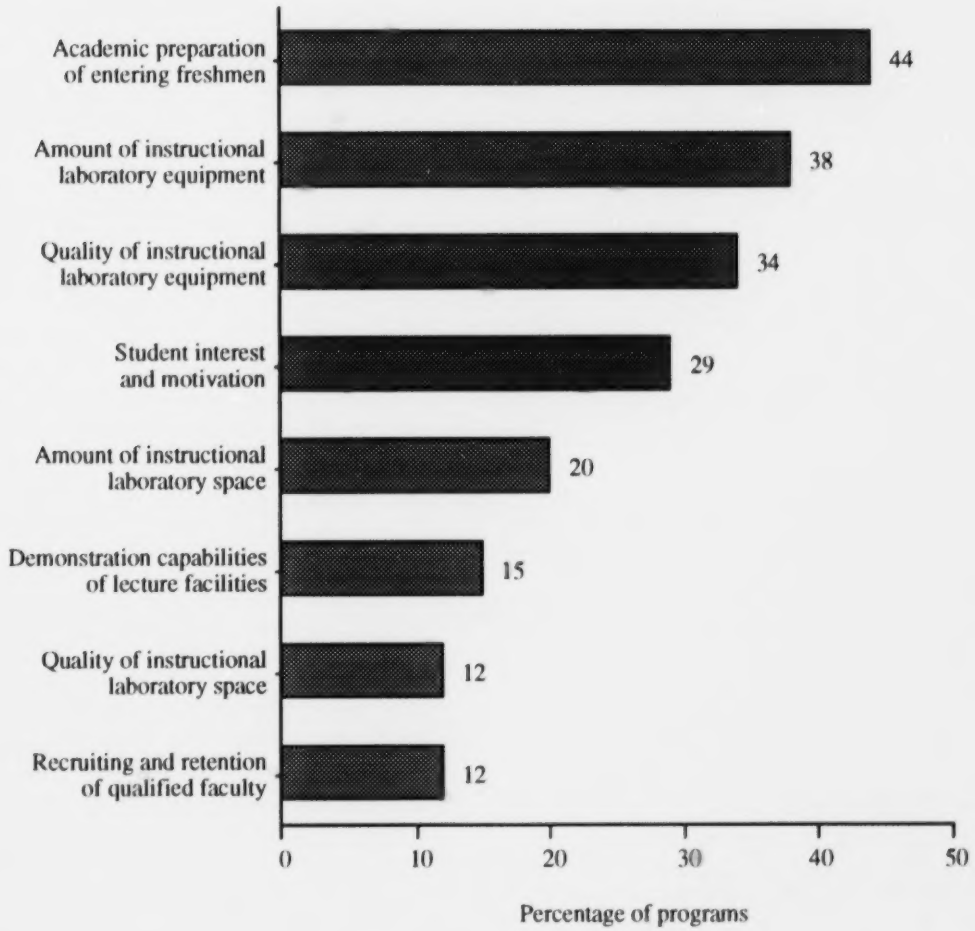
Although a substantial majority of department chairs reported that their undergraduate physics students had access to both departmental and campus computer resources, they gave relatively low ratings to departmental computer resources and only slightly higher evaluations of campus computer resources. Moreover, there was no significant variability on these ratings among chairs at the various types of institution.

Departmental Computer Resources

Eighty-five percent of chairs stated their department offered their undergraduate students access to departmental computers for undergraduate research and coursework. Chairs of departments that provided computer access for their students were asked to rate their computer resources on a five-point scale ranging from very poor to very good, and the scale was collapsed into three categories (poor, average, and good) for this analysis (Appendix Table A-2).

Only one aspect of departmental computer resources, the quality of the computer equipment, received a rating of "good" by the majority of chairs. Sixty-one percent of the chairs reported that the computer equipment available for undergraduate use was of good quality; however, only 37 percent gave the same rating to the amount of computer equipment available for undergraduate physics students, and 39 percent reported that the amount of equipment was poor. Evaluations of the quality of space for computer use and the amount of that space were similar to the ratings for the amount of computer equipment. About one-third of the chairs rated those resources as good, and about 40 percent judged them to be poor. The ratings for

Figure 1. Aspects of undergraduate education in physics ranked as the top three greatest problems by 10 percent or more of chairs of departments with physics programs: United States



SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

the quality of computer software followed the same pattern, with 31 percent of the chairs reporting good quality instructional software for their undergraduates and 42 percent reporting good quality software for undergraduate research. Thirty-eight percent of the chairs reported that their instructional software was of poor quality, and 31 percent gave that rating to the quality of their research software.

Campus-wide Computer Resources

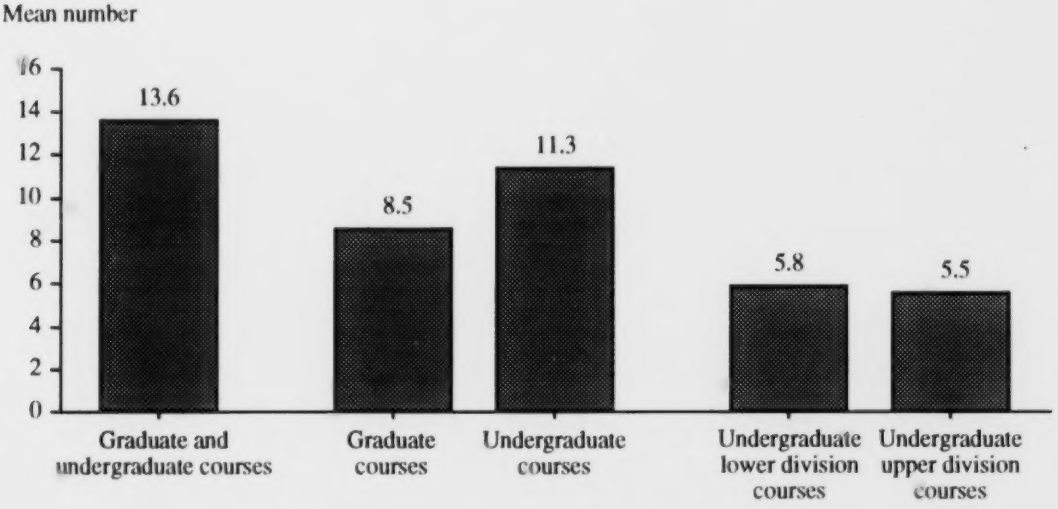
Over 90 percent of the department chairs reported that their students had access to campus-wide computer resources for undergraduate research and coursework. The quality and amount of campus computer equipment were rated as good by a higher percentage of chairs than the same characteristics of campus computer space, which, in turn, was rated as good by a greater percentage than gave that rating for campus software (Appendix Table A-3). For example, 61 percent of the chairs gave the quality of campus computer equipment to which their students had access a good rating, and 52 percent rated the amount of equipment as good. About 45 percent rated the quality and the amount of computer space as good, but less than one-third gave that rating to the quality of campus-wide software for undergraduate instruction or the quality of campus-wide software for undergraduate research. Thirty-four percent of the chairs rated instructional software as poor, while 41 percent gave that rating to the research software available to physics students through campus computers.

Course Offerings

Chairs of departments with physics programs reported that, in fall 1990, 13,920 graduate and undergraduate physics courses were offered by the 1,024 four-year colleges and universities with undergraduate programs in physics (Appendix Table A-4). Of these, 2,360 were graduate and 11,570 were undergraduate physics courses. The 11,570 undergraduate physics courses were split almost evenly between 5,930 lower division and 5,570 upper division courses.

The average (mean) number of combined graduate and undergraduate physics courses taught in departments with a program in physics in fall 1990 was 13.6 (Figure 2). An average of 8.5 graduate and 11.3 undergraduate courses were taught in physics programs by institutions offering courses at those levels. An average of 5.8 undergraduate lower division and 5.5 undergraduate upper division physics courses were offered by physics programs.

Figure 2. Mean number of physics courses taught in fall 1990, by course level: United States



NOTE: The mean number of total graduate and undergraduate physics courses is smaller than the sum of the mean number of graduate courses plus the mean number of undergraduate courses. This is due to differences in the bases used to calculate the means. An institution is included in the base used to calculate total means if the institution offered either graduate or undergraduate courses; an institution is included in the base number used to calculate the mean number of graduate and mean number of undergraduate courses only if the institution offered these specific types of courses. Other details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Slightly over half (57 percent) of the 13,920 physics courses were offered at public institutions and the remaining 43 percent were offered at private institutions (Appendix Table A-4). An average of 17.8 physics courses were offered by programs at public institutions, and an average of 10.3 courses were offered by programs at private institutions. By level of instruction, an average of 8.6 graduate physics courses were offered by programs at public institutions that offered graduate physics courses, and an average of 8.4 graduate physics courses were taught at private institutions that offered graduate physics courses.

The number of combined graduate and undergraduate physics courses taught by departments with physics programs at the different types of institutions ranged from 2,150 at doctoral institutions to 6,140 at comprehensive institutions. An average of 34.0 undergraduate and graduate physics courses were taught at research institutions, 22.4 at doctoral, 12.2 at comprehensive, and 6.7 at liberal arts institutions.

Instructional Staff

The survey collected two sets of counts of faculty providing instruction in physics. First, it requested the total number of full-time and part-time faculty who taught physics in fall 1990. Second, it asked for counts of faculty who taught physics to undergraduates. The survey requested the rank of full-time faculty in both categories--those who taught physics and those who taught physics to undergraduates. Later questionnaire items solicited additional information on the characteristics (i.e, highest degree, gender, and race/ethnicity) of faculty who taught physics to undergraduates.

Total Instructional Staff

In fall 1990 there were an estimated 8,740 faculty teaching graduate and undergraduate physics courses in the Nation's four-year colleges and universities (Table 4). Of these, 88 percent (7,730) were full-time faculty. Of the full-time faculty, 56 percent were full professors, 21 percent were associate professors, 20 percent were assistant professors, and 3 percent were lecturers or instructors (Figure 3). About 62 percent of full-time physics faculty were teaching at public institutions and the remaining 38 percent at private institutions. Figure 4 shows that 38 percent of full-time faculty were teaching physics at research institutions, 16 percent at doctoral institutions, 35 percent at comprehensive institutions, and 11 percent at liberal arts colleges.

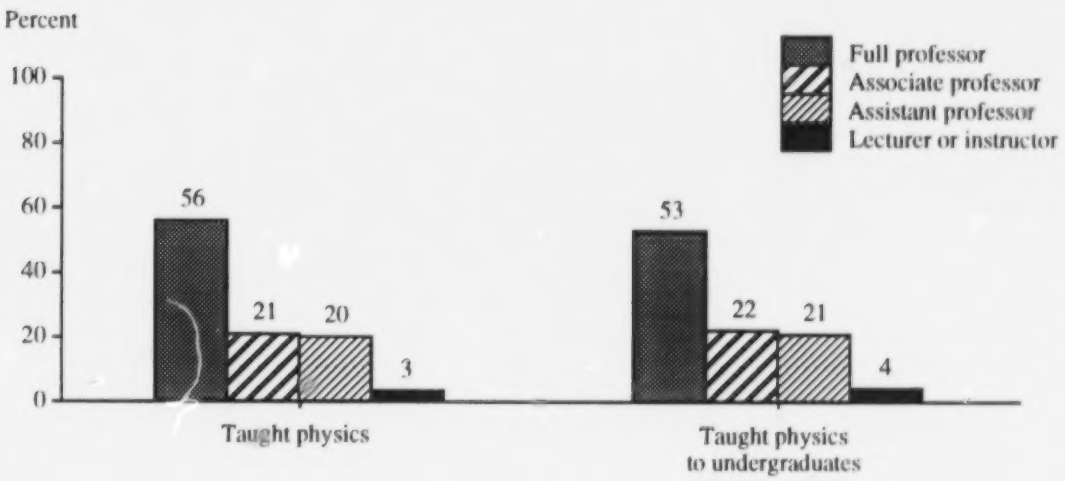
Table 4. Number of faculty, by faculty category, who taught physics in fall 1990, by control and type of institution: United States

Faculty category	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Number of four-year colleges and universities with physics departments	1,024	444	580	102	96	501	325
Total faculty	8,740	5,410	3,330	3,100	1,380	3,340	920
Total full-time faculty	7,730	4,800	2,930	2,940	1,230	2,740	820
Full professor	4,320	2,840	1,480	1,980	720	1,300	320
Associate professor	1,590	970	620	470	250	690	180
Assistant professor	1,520	810	700	440	220	600	260
Lecturer or instructor	250	170	90	50	30	120	50
Total part-time faculty	1,010	610	410	160	160	600	100

NOTE: The numbers of faculty have been rounded to the nearest 10. Details may not add to totals because of rounding. In addition, the total full-time faculty includes 50 unranked faculty members, who are not reported in the table because that category contained so few responses.

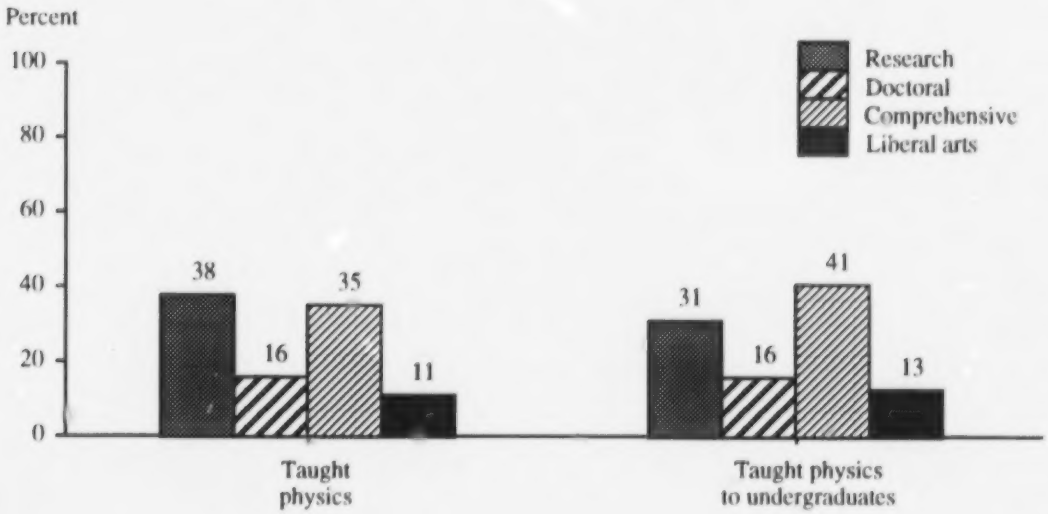
SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Figure 3. Percentage distribution of full-time faculty who taught physics and those who taught physics **to undergraduates** in fall 1990, by faculty rank: United States



SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Figure 4. Percentage distribution of full-time faculty who taught physics and those who taught physics **to undergraduates** in fall 1990, by institutional type: United States



NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

The average (mean) number of faculty in each program teaching physics in fall 1990 was 7.5 full-time and 1.0 part-time faculty (Table 5). The full-time faculty included, on average, 4.2 full professors, 1.6 associate professors, and 1.5 assistant professors. At public institutions, an average of 10.8 full-time faculty taught physics, and at private institutions, an average of 5.0 full-time faculty taught physics. The average number of full-time faculty teaching physics courses varied considerably by the type of institution in which the physics program was located. In fall 1990, an average of 28.8 full-time faculty were teaching physics at research universities, 12.8 at doctoral institutions, 5.5 at comprehensive institutions, and 2.5 at liberal arts colleges.

Table 5. Mean number of faculty, by faculty category, who taught physics in fall 1990, by control and type of institution: United States

Faculty category	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Number of four-year colleges and universities with physics departments . . .	1,024	444	580	102	96	501	325
Total faculty	8.5	12.2	5.7	30.4	14.4	6.6	2.8
Total full-time faculty. . . .	7.5	10.8	5.0	28.8	12.8	5.5	2.5
Full professor	4.2	6.4	2.6	19.4	7.5	2.6	1.0
Associate professor. . . .	1.6	2.2	1.1	4.6	2.6	1.4	0.6
Assistant professor. . . .	1.5	1.8	1.2	4.3	2.3	1.2	0.8
Lecturer or instructor. . .	0.2	0.4	0.2	0.5	0.3	0.2	0.2
Total part-time faculty. . . .	1.0	1.4	0.7	1.6	1.6	1.2	0.3

NOTE: Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Instructional Staff Teaching Undergraduates

There were an estimated 7,450 faculty members teaching physics to undergraduates in fall 1990, of which 87 percent (6,500) were full-time and 13 percent (950) were part-time faculty (Table 6). Of the full-time faculty teaching undergraduates, 53 percent were full professors, 22 percent were associate professors, 21 percent were assistant professors, and 4 percent were lecturers or instructors (Figure 3). The majority (61 percent) of the full-time faculty teaching undergraduates were located in programs at public institutions; the remaining 39 percent were at private institutions. Figure 4 shows that 31 percent of the full-time faculty teaching physics to undergraduates were teaching at research universities, 16 percent were teaching at doctoral universities, 41 percent at comprehensive institutions, and 13 percent at liberal arts colleges.

Table 6. Number of faculty, by faculty category, who taught physics **to undergraduates** in fall 1990, by control and type of institution: United States

Faculty category	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Number of four-year colleges and universities with physics departments . .	1,024	444	580	102	96	501	325
Total faculty	7,450	4,520	2,930	2,150	1,160	3,220	920
Total full-time faculty . . .	6,500	3,950	2,550	2,020	1,010	2,650	820
Full professor	3,450	2,240	1,210	1,300	570	1,260	320
Associate professor . . .	1,410	840	570	350	220	670	180
Assistant professor . . .	1,360	700	660	320	190	590	260
Lecturer or instructor . .	240	160	80	50	20	120	50
Total part-time faculty . . .	950	570	370	140	150	560	100

NOTE: The numbers of faculty have been rounded to the nearest 10. Details may not add to totals because of rounding. In addition, the total full-time faculty includes 40 unranked faculty members, who are not reported in the table because that category contained so few responses.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

The average (mean) number of faculty in each program teaching physics to undergraduates was 6.3 full-time and 0.9 part-time faculty (Table 7). The full-time faculty members included, on average, 3.4 full professors, 1.4 associate professors, and 1.3 assistant professors. At public institutions, there were an average of 8.9 full-time faculty teaching physics to undergraduates; at private institutions, the average was 4.4 full-time faculty members teaching physics to undergraduates.

Physics programs located at research institutions were considerably larger in terms of the mean number of full-time faculty teaching physics to undergraduates than programs at doctoral, comprehensive, and liberal arts institutions. There were an average of 19.8 full-time faculty teaching undergraduates at research institutions, compared to an average of 10.5 at doctoral institutions, 5.3 at comprehensive institutions, and 2.5 at liberal arts colleges. At research, doctoral, and comprehensive institutions, the largest average number of full-time faculty teaching physics to undergraduates held the rank of full professor.

Table 7. Mean number of faculty, by faculty category, who taught physics **to undergraduates** in fall 1990, by control and type of institution: United States

Faculty category	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Number of four-year colleges and universities with physics departments	1,024	444	580	102	96	501	325
Total faculty	7.3	10.2	5.0	21.1	12.1	6.4	2.8
Total full-time faculty	6.3	8.9	4.4	19.8	10.5	5.3	2.5
Full professor	3.4	5.0	2.1	12.7	6.0	2.5	1.0
Associate professor	1.4	1.9	1.0	3.4	2.3	1.3	0.5
Assistant professor	1.3	1.6	1.1	3.1	2.0	1.2	0.8
Lecturer or instructor	0.2	0.4	0.1	0.5	0.2	0.2	0.2
Total part-time faculty	0.9	1.3	0.6	1.3	1.5	1.1	0.3

NOTE: Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Most (84 percent) full-time faculty who taught physics also taught physics to undergraduates (Table 8). By faculty rank, the percentage ranged from 80 percent of full professors to 95 percent of lecturers or instructors. There was considerable variation by institutional type. Only 68 percent of full-time physics faculty at research institutions taught physics to undergraduates; the proportions were 83 percent at doctoral, 97 percent at comprehensive, and 100 percent at liberal arts institutions.

Table 8. Percentage of physics faculty, by faculty category, who taught physics **to undergraduates** in fall 1990, by control and type of institution: United States

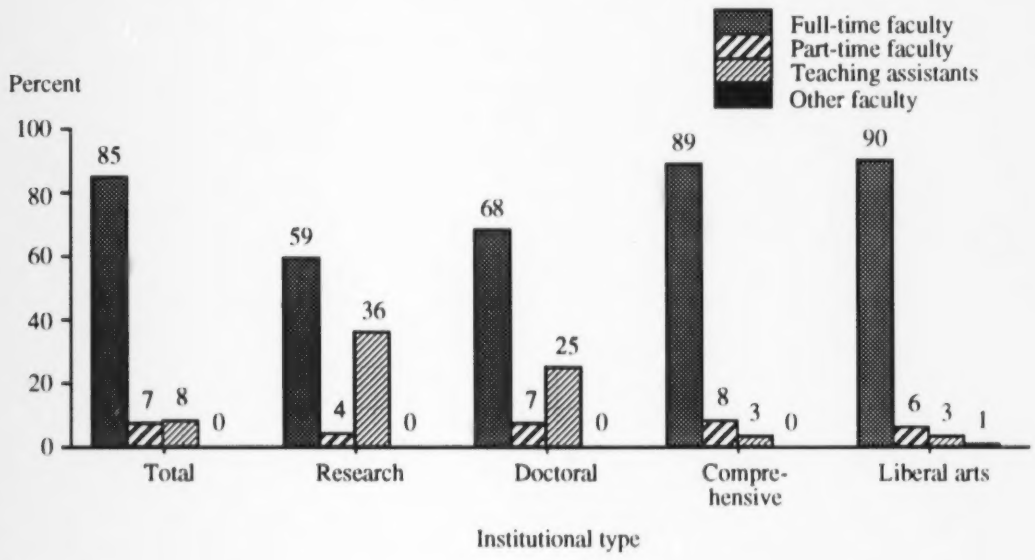
Faculty category	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Total full-time faculty . . .	84	82	87	68	83	97	100
Full professor	80	79	82	65	80	97	100
Associate professor . . .	89	86	92	74	86	97	99
Assistant professor . . .	89	86	93	74	87	98	100
Lecturer or instructor . .	95	96	93	91	88	96	100
Total part-time faculty . . .	93	94	92	86	94	94	100

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Mean Instructional Contact Hours

For fall 1990, chairs of departments with physics programs reported that an average of 85 percent of the contact hours for undergraduate instruction were taught by full-time faculty (Figure 5). "Contact hours" was defined to include lectures, laboratories, and discussion groups. The remaining 15 percent of instructional contact hours were provided by teaching assistants (8 percent) and part-time faculty (7 percent). There was considerable variation by institutional type, which was strongly influenced by the presence of teaching assistants at the various types of institutions. Most instructional contact hours at liberal arts colleges (90 percent) and comprehensive institutions (89 percent) were provided by full-time faculty, while at research and doctoral institutions, 59 percent and 68 percent, respectively, of the instructional contact hours were provided by full-time faculty. Teaching assistants provided only 3 percent of the instructional contact hours at both liberal arts and comprehensive institutions, while at research and doctoral institutions, teaching assistants provided 36 percent and 25 percent, respectively, of the instructional contact hours.

Figure 5. Mean percentage of undergraduate instructional contact hours in physics programs in fall 1990 for various types of teaching staff, by institutional type: United States



NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Highest Degree

The vast majority (92 percent) of full-time faculty teaching physics to undergraduates in fall 1990 held doctoral degrees (Table 9). The remaining 8 percent held master's degrees as their highest degree. The pattern was the same at both public and private institutions, with 90 percent or more of the full-time undergraduate faculty holding doctorates. Full-time faculty at research and doctoral institutions were more likely than those at comprehensive and liberal arts institutions to have doctorates.

Part-time faculty teaching undergraduates tended to have doctorate degrees (51 percent) more often than master's degrees (37 percent) or bachelor's degrees (12 percent). Part-time faculty at research and doctoral institutions were more likely than part-time faculty at comprehensive or liberal arts institutions to have a doctorate as their highest degree.

Table 9. Percentage of full-time and part-time faculty, by highest degree, who taught physics to **undergraduates** in fall 1990, by control and type of institution: United States

Highest degree	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Full-time faculty							
Doctorate	92	93	90	99	97	87	84
Master's	8	7	10	1	3	13	15
Bachelor's	*	*	1	*	*	*	1
Part-time faculty							
Doctorate	51	53	47	80	63	41	48
Master's	37	35	40	12	34	44	40
Bachelor's	12	11	13	8	3	15	11

* = less than 0.5 percent.

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

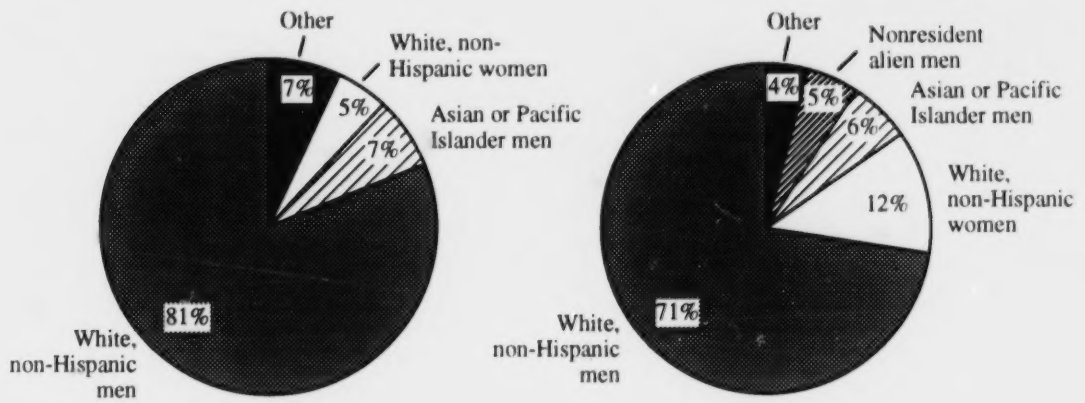
Gender and Race/Ethnicity

The full-time faculty members who taught physics to undergraduates in fall 1990 were 86 percent white, non-Hispanic (81 percent men and 5 percent women), 8 percent Asian (7 percent men and 1 percent women), 2 percent black, non-Hispanic men, 2 percent Hispanic men, and 2 percent nonresident alien men (Appendix Table A-5 and Figure 6). The racial/ethnic and gender distributions of faculty were similar regardless of institutional control or type.

The gender distribution of part-time undergraduate physics faculty differed slightly from the distribution of full-time faculty, but racial/ethnic proportions were similar (Appendix Table A-6 and Figure 6). Eighty-three percent of part-time undergraduate faculty were white, non-Hispanic (compared to 86 percent for full-time faculty), with the majority (71 percent) being white, non-Hispanic men, and 12 percent being white, non-Hispanic women (compared to 81 percent and 5 percent, respectively, for full-time faculty). Asian men (6 percent) and nonresident alien men (5 percent) accounted for most of the remainder of the part-time undergraduate faculty.

When compared to national figures for all full-time faculty, Asian representation among undergraduate physics faculty was higher and black representation was lower than among all faculty. National

Figure 6. Percentage distribution of full-time and part-time faculty who taught physics **to undergraduates** in fall 1990, by racial/ethnic group and gender: United States



NOTE: Percentages may not add to 100 because of rounding. Other full-time faculty includes 2 percent black, non-Hispanic men, 2 percent nonresident alien men, 2 percent Hispanic men, and 1 percent Asian or Pacific Islander women. Other part-time faculty includes 2 percent black, non-Hispanic men, 1 percent Hispanic women, and 1 percent Asian or Pacific Islander women.

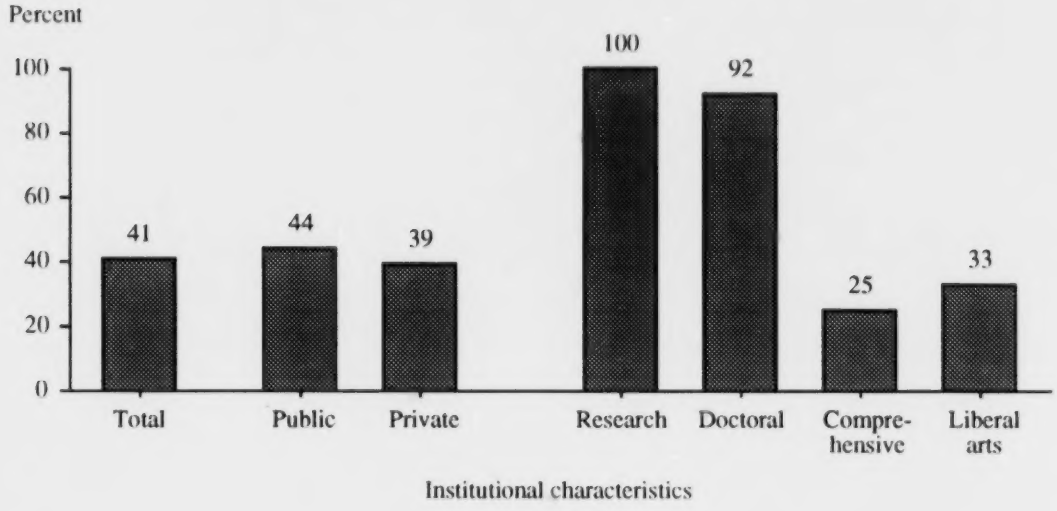
SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

estimates of the race/ethnicity of full-time faculty in the Nation's colleges and universities were 5 percent Asian and 4 percent black. Figures for whites and Hispanics were 88 percent and 2 percent, respectively.[7]

Teaching Assistants

Less than half (41 percent) of the departments offering programs in physics had teaching assistants (TAs) in fall 1990 (Figure 7). Chairs at all of the research institutions and chairs at 92 percent of the doctoral institutions indicated that their physics programs used TAs. In comparison, only 33 percent of department chairs at liberal arts colleges and 25 percent of those at comprehensive institutions reported using TAs in their programs. The mean percentage of TAs who were graduate students was 56 percent (Figure 8). There was considerable variation by institutional type, ranging from 1 percent graduate student TAs at liberal arts colleges to 95 percent at research institutions; this variation is related to the availability of graduate students at those types of institutions (since by definition, liberal arts colleges are primarily undergraduate colleges, and therefore graduate students are much less likely to be available as TAs).

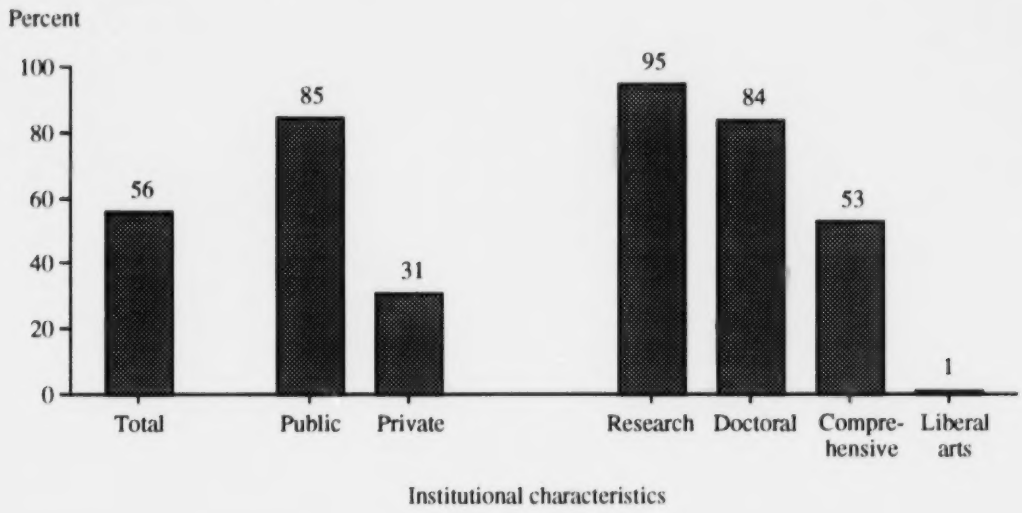
Figure 7. Percentage of departments with physics programs that had teaching assistants in fall 1990, by control and type of institution: United States



SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

[7] *The Chronicle of Higher Education Almanac*; August 28, 1991, p.29.

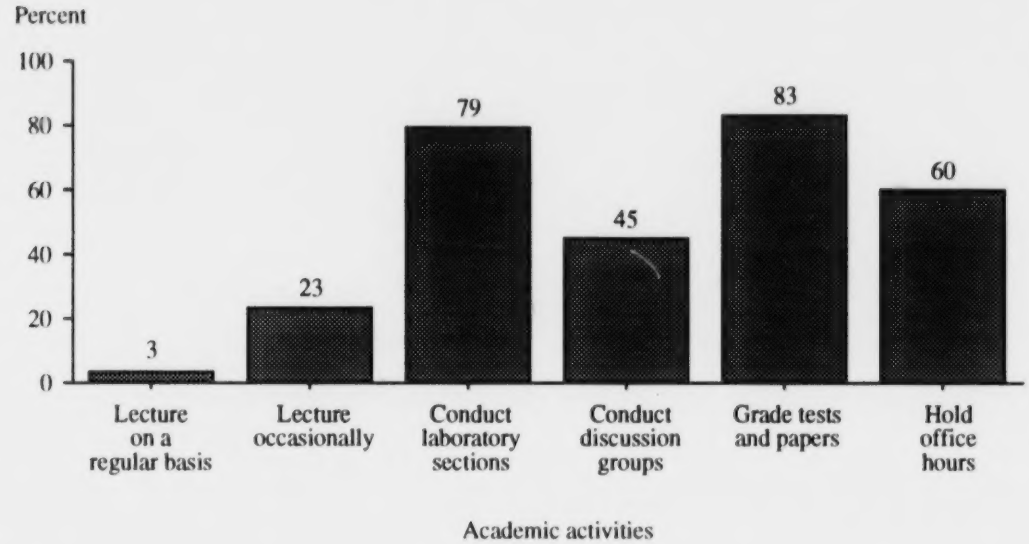
Figure 8. Percentage of physics teaching assistants in fall 1990 who were graduate students, by institutional type: United States



SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Teaching assistants performed a variety of academic activities in physics programs (Figure 9). Most of the department chairs (83 percent) stated that TAs were used to grade tests and papers, 79 percent indicated that TAs conducted laboratory sections, and 60 percent said TAs held office hours. TAs were used to a lesser extent to conduct discussion groups (45 percent) and lecture occasionally (23 percent). Only 3 percent of department chairs indicated that their TAs lectured on a regular basis. Teaching assistants conducted, on average, 2.1 laboratory sections or discussion groups for each term (unpublished tabulation).

Figure 9. Percentage of teaching assistants in departments with physics programs who performed various kinds of academic activities: United States



SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Only about a third (37 percent) of the programs that had TAs offered a course or seminar (at the institution or department level) to enhance the teaching and communication skills of teaching assistants (unpublished tabulation). The topic most frequently covered was teaching techniques, covered by 86 percent of the programs that offered a course or seminar for TAs. Also frequently covered were preparation of course material and English language skills, covered by 58 percent and 57 percent, respectively, of the programs with a course or seminar for TAs. Department chairs at 61 percent of the programs with a course or seminar for TAs required all teaching assistants to attend; 33 percent required only some teaching assistants to attend, and 6 percent did not require any teaching assistants to attend.

APPENDIX A
Detailed Tables

Detailed Tables

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Table A-1. Percentage of chairs of departments with physics programs who rated various aspects of undergraduate education in their department as poor, average, or good, by type of institution: United States

Aspect of undergraduate education	Total	Type			
		Research	Doctoral	Comprehensive	Liberal arts
Academic preparation of entering freshmen					
Poor	35	24	39	37	33
Average	48	46	48	51	43
Good	18	30	13	12	24
Student interest and motivation					
Poor	17	8	21	18	17
Average	47	38	45	51	42
Good	36	53	34	30	41
Computer background of students					
Poor	35	22	29	36	38
Average	50	49	51	48	52
Good	16	28	20	16	10
Quality of introductory textbooks					
Poor	3	13	1	1	3
Average	22	21	16	18	30
Good	75	66	83	80	67
Quality of advanced textbooks					
Poor	2	1	0	3	2
Average	11	12	11	12	11
Good	86	87	89	85	87
Opportunity for undergraduate research through independent study or advanced coursework					
Poor	18	7	8	24	18
Average	22	9	17	24	25
Good	60	84	75	53	57
Quality of instructional laboratory equipment					
Poor	31	36	42	28	30
Average	36	32	28	38	36
Good	33	32	30	34	33

Table A-1. Percentage of chairs of departments with physics programs who rated various aspects of undergraduate education in their department as poor, average, or good, by type of institution: United States (continued)

Aspect of undergraduate education	Total	Type			
		Research	Doctoral	Comprehensive	Liberal arts
Amount of instructional laboratory equipment					
Poor	44	32	43	47	44
Average	30	29	33	28	33
Good	26	39	23	25	22
Quality of instructional laboratory space					
Poor	20	13	31	19	21
Average	34	31	25	40	29
Good	46	56	44	41	50
Amount of instructional laboratory space					
Poor	30	26	37	32	26
Average	28	28	30	32	22
Good	42	46	33	36	52
Demonstration capabilities of lecture facilities					
Poor	44	30	51	51	36
Average	31	23	32	26	40
Good	25	47	16	23	24
Appropriateness of class size for introductory courses					
Poor	12	36	18	11	3
Average	19	27	35	17	14
Good	69	37	47	72	82
Appropriateness of class size for advanced courses					
Poor	5	2	5	4	9
Average	10	6	10	9	11
Good	85	92	85	87	80
Recruiting and retention of qualified faculty					
Poor	15	8	10	18	15
Average	24	19	19	27	23
Good	61	73	71	55	62

Table A-1. Percentage of chairs of departments with physics programs who rated various aspects of undergraduate education in their department as poor, average, or good, by type of institution: United States (continued)

Aspect of undergraduate education	Total	Type			
		Research	Doctoral	Comprehensive	Liberal arts
Language abilities of faculty members whose first language is not English					
Poor	5	7	4	3	8
Average	20	18	25	24	13
Good	75	76	71	74	79
Availability of teaching assistants					
Poor	22	13	29	26	18
Average	30	35	26	27	33
Good	48	51	45	47	50
Quality of teaching assistants					
Poor	11	9	21	9	7
Average	38	50	36	33	34
Good	52	40	43	58	59
Language abilities of teaching assistants whose first language is not English					
Poor	42	48	60	30	11
Average	38	37	33	49	29
Good	20	15	7	22	59

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Table A-2. Percentage of departments with physics programs that have computer equipment located within the department to which undergraduates have access, and the percentage of department chairs rating these departmental computer resources as poor, average, or good, by type of institution: United States

Departmental computer resources	Total	Type			
		Research	Doctoral	Comprehensive	Liberal arts
Have computer equipment in department	85	89	88	85	81
Quality of computer equipment					
Poor	16	18	20	15	16
Average	23	26	20	22	25
Good	61	57	60	63	59
Amount of computer equipment					
Poor	39	40	35	40	39
Average	23	30	23	24	21
Good	37	30	41	36	41
Quality of space for computer use					
Poor	37	34	42	40	34
Average	29	40	29	23	34
Good	34	27	30	37	33
Amount of space for computer use					
Poor	43	41	41	45	41
Average	26	33	32	23	25
Good	31	27	26	32	34
Quality of software for undergraduate instruction					
Poor	38	44	39	40	32
Average	30	34	29	26	37
Good	31	22	32	33	31
Quality of software for undergraduate research					
Poor	31	16	26	37	29
Average	27	30	23	25	30
Good	42	54	51	38	41

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Table A-3. Percentage of departments with physics programs that have campus-wide computer equipment to which undergraduates have access, and the percentage of department chairs rating these campus-wide computer resources as poor, average, or good, by type of institution: United States

Campus-wide computer resources	Total	Type			
		Research	Doctoral	Comprehensive	Liberal arts
Have campus-wide computer equipment	92	98	98	93	88
Quality of computer equipment					
Poor	9	5	11	9	9
Average	30	32	28	32	28
Good	61	63	61	59	63
Amount of computer equipment					
Poor	16	17	14	19	12
Average	32	35	36	31	29
Good	52	48	50	49	59
Quality of space for computer use					
Poor	16	18	14	17	15
Average	36	41	43	39	28
Good	47	41	43	44	57
Amount of space for computer use					
Poor	18	24	21	17	19
Average	39	42	40	41	33
Good	43	34	40	42	48
Quality of software for undergraduate instruction					
Poor	34	44	28	33	34
Average	35	31	44	37	30
Good	31	25	28	31	35
Quality of software for undergraduate research					
Poor	41	33	30	43	42
Average	29	29	33	25	33
Good	31	37	37	32	24

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Table A-4. Total number and mean number of physics courses taught in fall 1990, by control and type of institution: United States

Number of physics courses	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Number of four-year colleges and universities with physics departments . .	1,024	444	580	102	96	501	325
Total graduate and undergraduate physics courses							
Total number.	13,920	7,920	6,000	3,470	2,150	6,140	2,160
Mean number	13.6	17.8	10.3	34.0	22.4	12.2	6.7
Total graduate physics courses							
Total number.	2,360	1,680	680	1,250	680	420	10
Mean number*.	8.5	8.6	8.4	12.4	8.8	4.4	2.5
Total undergraduate physics courses							
Total number.	11,570	6,240	5,320	2,220	1,470	5,720	2,160
Mean number	11.3	14.1	9.2	21.7	15.3	11.4	6.6
Lower division physics courses							
Total number.	5,930	3,190	2,730	1,120	730	2,860	1,220
Mean number	5.8	7.2	4.7	11.1	7.7	5.7	3.8
Upper division physics courses							
Total number.	5,570	3,020	2,550	1,070	720	2,840	930
Mean number	5.5	6.8	4.4	10.6	7.6	5.7	2.9

*Based on programs that offered graduate physics courses.

NOTE: The mean number of total graduate and undergraduate physics courses is smaller than the sum of the mean number of graduate courses plus the mean number of undergraduate courses. This is due to differences in the bases used to calculate the means. An institution is included in the base used to calculate total means if the institution offered either graduate or undergraduate courses; an institution is included in the base number used to calculate the mean number of graduate and mean number of undergraduate courses only if the institution offered these specific types of courses. The total number of courses have been rounded to the nearest 10. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Table A-5. Percentage of full-time faculty, by racial/ethnic group and gender, who taught physics **to undergraduates** in fall 1990, by control and type of institution: United States

Racial/ethnic group and gender	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Total number of full-time faculty who taught physics to undergraduates in fall 1990.	6,500	3,950	2,550	2,020	1,010	2,650	820
Nonresident aliens							
Men.	2	2	1	2	2	1	1
Women	*	*	*	*	*	*	*
U.S. citizens and permanent residents							
Black, non-Hispanic							
Men.	2	1	3	1	2	2	3
Women	*	*	*	*	0	*	1
White, non-Hispanic							
Men.	81	81	82	82	82	81	78
Women	5	4	7	4	3	6	9
Hispanic							
Men.	2	2	1	1	1	2	2
Women	*	*	*	*	0	*	*
Asian or Pacific Islander							
Men.	7	8	5	9	9	7	4
Women	1	1	*	1	*	1	1
American Indian or Alaskan Native							
Men.	*	*	*	0	0	*	*
Women	*	*	0	0	0	*	0

* = less than 0.5 percent.

NOTE: The numbers of faculty have been rounded to the nearest 10. Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Table A-6. Percentage of part-time faculty, by racial/ethnic group and gender, who taught physics **to undergraduates** in fall 1990, by control and type of institution: United States

Racial/ethnic group and gender	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Total number of part-time faculty who taught physics to undergraduates in fall 1990.	950	570	370	140	150	560	100
Nonresident aliens							
Men.	5	6	4	5	6	5	5
Women	*	1	0	2	1	0	0
U.S. citizens and permanent residents							
Black, non-Hispanic							
Men.	2	2	1	0	2	2	3
Women	*	0	1	0	0	0	3
White, non-Hispanic							
Men.	71	65	80	73	73	70	73
Women	12	15	9	9	11	14	8
Hispanic							
Men.	*	*	0	1	1	0	0
Women	1	1	1	0	0	1	5
Asian or Pacific Islander							
Men.	6	7	5	7	6	7	4
Women	1	2	0	3	1	1	0
American Indian or Alaskan Native							
Men.	0	0	0	0	0	0	0
Women	0	0	0	0	0	0	0

* = less than 0.5 percent.

NOTE: The numbers of faculty have been rounded to the nearest 10. Details may not add to totals because of rounding. Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

APPENDIX B
Technical Notes

Higher Education Surveys

The Higher Education Surveys (HES) system was established to conduct brief surveys of higher education institutions on topics of interest to Federal policy makers and the education community. The system is sponsored by the National Science Foundation, the U.S. Department of Education, and the National Endowment for the Humanities.

HES questionnaires typically request a limited amount of readily accessible data from a subsample of institutions in the HES panel, which is a nationally representative sample of 1,134 colleges and universities in the United States. Each institution in the panel has identified a HES campus representative, who serves as survey coordinator. The campus representative facilitates data collection by identifying the appropriate respondent for each survey and distributing the questionnaire to that person.

Survey Methodology

This mail survey was conducted at the request of the National Science Foundation (NSF) to provide information about instructional staff, computer resources, course offerings, and issues and concerns of departments teaching undergraduates.

The sample for this survey consisted of all the research (n=104), doctoral (n=106), and liberal arts institutions (n=180), and half of the comprehensive institutions (n=150) in the HES panel (n=540), and 57 historically black colleges and universities (HBCUs) that are not part of the HES panel. A packet containing questionnaires for geology, physics, and sociology programs, plus a cover letter, respondent designation form, and information copy of the questionnaire were sent to HES coordinators at these 597 institutions on February 27, 1991.* At the HBCUs, personalized letters were sent to the president of the institution, in lieu of a HES coordinator. The letter requested the institution's participation and asked that the coordinator pass the questionnaires along to the chairs of the geology, physics, and sociology departments, or the departments that offer undergraduate programs in geology, physics, and sociology. The coordinator was asked to return the respondent designation form, indicating to whom the questionnaires were sent. Telephone followup with coordinators who had not returned their respondent designation forms began on March 18; telephone followup calls for questionnaire nonresponse began on March 25. Data collection was completed on June 7, 1991.

An overall response rate of 95 percent was obtained for each discipline. However, as shown in Appendix Table B-1, the number of institutions that offered programs in each discipline varied widely. Of the 597 institutions to which questionnaires were sent, 275 offered geology programs, 475 offered physics programs, and 529 offered sociology programs. Of these eligible programs, completed questionnaires were received from 262 geology programs, 450 physics programs, and 502 sociology programs. Response rates by

*Findings from the surveys of geology and sociology are available in separate reports.

Table B-1. Unweighted response rates for the geology, physics, and sociology questionnaires by institutional type

Discipline and institutional type	Complete	Nonresponse	Refusal	Ineligible*	Total
Geology					
Total	262	4	9	322	597
Research	92	1	3	8	104
Doctoral	70	1	1	34	106
Comprehensive	70	1	5	74	150
Liberal arts	28	1	0	151	180
Historically black colleges and universities	2	0	0	55	57
Physics					
Total	450	6	19	122	597
Research	97	1	4	2	104
Doctoral	90	0	5	11	106
Comprehensive	124	1	7	18	150
Liberal arts	103	3	2	72	180
Historically black colleges and universities	36	1	1	19	57
Sociology					
Total	502	9	18	68	597
Research	94	1	3	6	104
Doctoral	91	1	2	12	106
Comprehensive	135	1	4	10	150
Liberal arts	134	5	6	35	180
Historically black colleges and universities	48	1	3	5	57

*An institution was counted as ineligible for a particular discipline if the institution did not have an undergraduate program in that discipline.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

type of institution ranged from 92 to 100 percent. Data were adjusted for questionnaire nonresponse and weighted to national totals using the following procedures. A separate base weight was calculated for each of the adjustment classes, which were formed based on the stratum to which the school was assigned for sampling, and whether or not the school was an historically black college or university. The base weights for the adjustment classes were based upon the probability of selection of the sampled institutions within each adjustment class. Nonresponse weights were also calculated for each adjustment class, based on the ratio of the sum of the number of responses and the number of refusals to the number of responses. The final weight was the product of the base weight and the nonresponse weight. Appendix Table B-2 shows the universe size (i.e., weighted number of institutions), the unweighted number of eligible institutions, and the unweighted number of responding institutions by institutional characteristics for each discipline. Historically black colleges and universities (HBCUs) were placed in their appropriate institutional control and type for analyses. HBCUs met the criteria for inclusion in both institutional control categories (i.e., public and private), and all institutional type categories (i.e., research, doctoral, comprehensive, and liberal arts).

The item response rate was 99 percent or higher for all items on the questionnaire. Thus, item nonresponse was minimal, and statistics presented in this reported may be interpreted as representing all physics programs as defined in this survey.

Reliability of Survey Estimates

The findings presented in this report are estimates based on the sample from the HES panel and, consequently, are subject to sampling variability. If the questionnaire had been sent to a different sample, the responses would not have been identical; some figures might have been higher, while others might have been lower. The standard error is a measure of the variability due to sampling when estimating a statistic. It indicates how much variability there is in the population of possible estimates of a parameter for a given sample size. Standard errors can be used as a measure of the precision expected from a particular sample. If all possible samples were surveyed under similar conditions, intervals of 1.96 standard errors below to 1.96 standard errors above a particular statistic would include the true population parameter being estimated in about 95 percent of the samples. This is a 95 percent confidence interval. For example, the estimated percentage of physics programs at public institutions rating the academic preparation of entering freshmen as poor is 46.8 percent and the estimated standard error is 2.7. The 95 percent confidence interval for this statistic extends from 46.8 - (2.7 times 1.96) to 46.8 + (2.7 times 1.96), or from 41.5 to 52.1 percent. This means one can be 95 percent confident that this interval contains the true population value. Estimates of standard errors for the estimates were computed using a replication technique known as jackknife replication. Some key statistics and their estimated standard errors are shown in Appendix Table B-3.

Table B-2. Universe size, unweighted number of eligible institutions, and unweighted number of responding institutions, by institutional characteristics for each discipline

Discipline and institutional characteristic	Universe*	Unweighted	
		Eligible	Respondents
Geology			
Total	489	275	262
Control			
Public	334	197	188
Private	155	78	74
Type			
Research	96	96	92
Doctorate	72	74	70
Comprehensive	237	76	72
Liberal arts	85	29	28
Physics			
Total	1,024	475	450
Control			
Public	444	251	238
Private	580	224	212
Type			
Research	102	102	97
Doctorate	96	96	91
Comprehensive	501	154	145
Liberal arts	325	123	117
Sociology			
Total	1,174	529	502
Control			
Public	475	261	249
Private	699	268	253
Type			
Research	98	98	94
Doctorate	95	95	92
Comprehensive	534	164	157
Liberal arts	447	172	159

*Universe sizes are based on sample data that have been weighted to produce national estimates. Because these estimates are subject to sampling variability, the breakouts by institutional characteristics may not equal the total.

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

Table B-3. Selected standard errors by institutional characteristics: United States

Question	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Percent of institutions conferring bachelor's degrees							
Estimate	78.6	83.2	75.2	100.0	98.8	79.2	65.1
Standard error	1.9	2.4	2.8	*	*	2.5	4.0
Percent of institutions in which respondents rated the academic preparation of freshmen as poor							
Estimate	34.6	46.8	25.5	24.1	39.1	37.1	32.8
Standard error	1.8	2.7	2.4	*	*	2.7	3.7
Percent of institutions in which respondents rated the opportunity for undergraduate research as good							
Estimate	59.8	59.3	60.3	83.5	74.9	52.7	57.4
Standard error	2.1	1.4	3.7	*	*	3.7	3.9
Percent of institutions in which respondents rated the recruiting and retention of qualified faculty as good							
Estimate	60.6	57.2	63.3	73.2	70.6	54.8	62.0
Standard error	1.9	1.9	3.1	*	*	3.0	3.8
Percent of institutions with computer equipment located within the department							
Estimate	84.6	84.4	84.7	88.7	87.8	85.5	80.9
Standard error	1.7	2.0	2.7	*	*	2.5	3.8
Percent of institutions in which respondents rated the quality of departmental computer equipment as good							
Estimate	60.9	57.4	63.6	56.9	59.9	62.9	59.4
Standard error	2.8	3.7	4.0	*	*	4.4	5.9
Percent of institutions in which respondents indicated that the number of physics majors has increased over the last 5 years							
Estimate	26.5	30.6	23.0	26.7	32.0	26.0	24.7
Standard error	2.1	2.9	3.0	*	*	3.7	4.1
Total number of physics courses taught							
Estimate	13,923.1	7,921.1	6,002.0	3,468.0	2,152.5	6,139.2	2,163.4
Standard error	354.2	198.0	294.8	*	*	333.7	118.7

Table B-3. Selected standard errors by institutional characteristics: United States (continued)

Question	Total	Control		Type			
		Public	Private	Research	Doctoral	Comprehensive	Liberal arts
Total number of full-time faculty teaching physics							
Estimate	7,727.7	4,802.3	2,925.4	2,942.3	1,225.7	2,735.6	824.1
Standard error	119.8	86.1	84.0	*	*	109.8	47.9
Total number of full-time faculty teaching physics to undergraduates							
Estimate	6,502.3	3,949.1	2,553.2	2,015.1	1,012.2	2,653.5	821.5
Standard error	114.4	81.2	81.7	*	*	104.1	47.6

*The estimated standard error is zero for research and doctoral institutions, because all research and doctoral institutions were included in the sample with certainty. However, the bias component, which cannot be estimated with standard errors, contributes to the total error because of nonresponse adjustments. The total error will be very small, because the amount of nonresponse is very small (see Appendix Table B-1).

SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

For categorical data, relationships between variables with two or more levels have been tested in a two-way analysis, using chi-square tests at the 0.5 level of significance, adjusted for average design effect. If the overall chi-square test was significant, it was followed with tests using a Bonferroni t statistic, which maintained an overall 95 percent confidence level or better. Unless noted otherwise, all comparisons made in this report were statistically significant using these tests.

Survey estimates are also subject to errors of reporting and errors made in the collection of the data. These errors, called nonsampling errors, can sometimes bias the data. While general sampling theory can be used to determine how to estimate the sampling variability of a statistic, nonsampling errors are not easy to measure and usually require that an experiment be conducted as part of the data collection procedures or the use of data external to the study.

Nonsampling errors may include such factors as differences in the respondents' interpretation of the meaning of the questions, differences related to the particular time the survey was conducted, or errors in data preparation. During the design of the survey and survey pretest, an effort was made to check for consistency of interpretation of questions and to eliminate ambiguous items. The questionnaire was pretested with respondents like those who completed the survey, and the questionnaire and instructions were extensively reviewed by the National Science Foundation. Manual and machine editing of the questionnaires were conducted to check the data for accuracy and consistency. Cases with missing or inconsistent items were recontacted by telephone; data were keyed with 100 percent verification.

Relationships of Institutional Characteristics

The data in this report are presented as "total" figures, which represent all kinds of four-year institutions grouped together, and for institutions broken down by institutional control and "type." Historically black colleges and universities were placed in their appropriate institutional control and type for analyses. These classifications are as follows:

- Institutional control
  - Public
  - Private
- Institutional type (based on the 1987 Carnegie classifications, which groups institutions into categories on the basis of the level of degree offered and the comprehensiveness of their missions)
  - Research universities: offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research.

- Doctorate-granting universities: offer a full range of baccalaureate programs, and are committed to graduate education through the doctorate.

- Comprehensive universities and colleges: offer baccalaureate programs, award more than half of their baccalaureate degrees in two or more occupational or professional disciplines, enroll at least 1,500 students, and frequently also offer graduate education through the master's degree.

- Liberal arts colleges: are primarily undergraduate colleges, and award more than half of their baccalaureate degrees in liberal arts fields.

As can be seen in Figures B-1 and B-2, these institutional characteristics are related to each other:

- Among research universities, 68 percent are public.
- Among doctorate-granting universities, 59 percent are public.
- Among comprehensive colleges, 55 percent are public.
- Among liberal arts colleges, 94 percent are private.
- Among nonspecialized four-year public colleges and universities, 66 percent are comprehensive colleges, and 27 percent are about evenly split between research and doctorate-granting universities.
- Among nonspecialized four-year private colleges and universities, 61 percent are liberal arts colleges and 30 percent are comprehensive colleges.

Figure B-1. Percentages of each type of nonspecialized four-year colleges and universities that are public and private

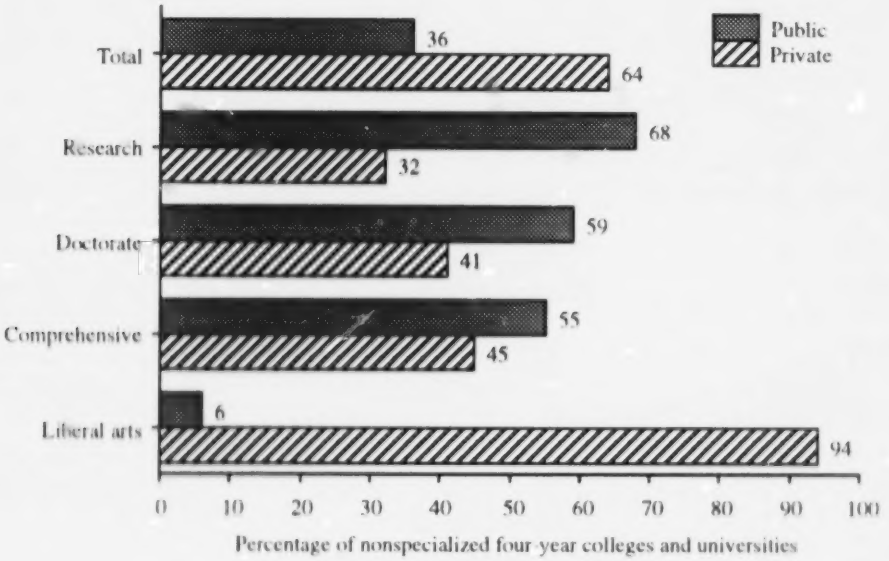
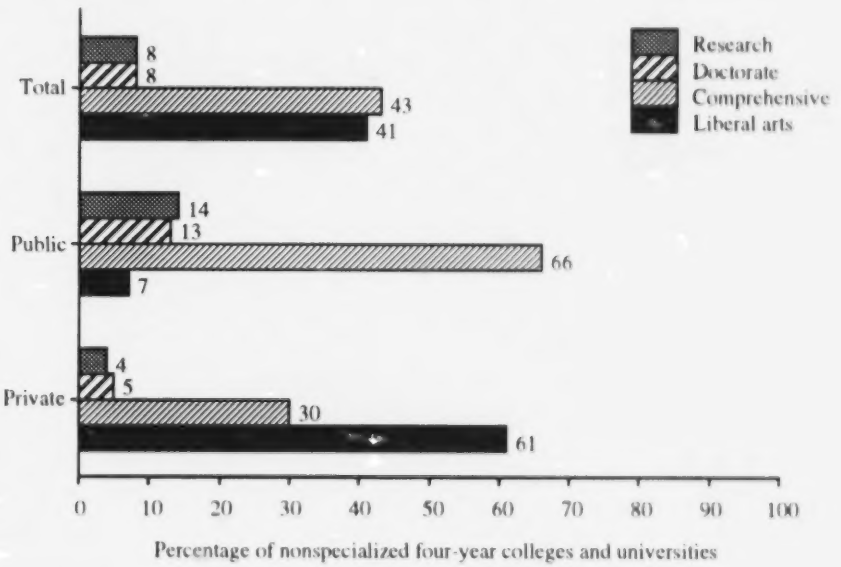


Figure B-2. Percentages of public, private, and all nonspecialized four-year colleges and universities that are research, doctorate, comprehensive, and liberal arts institutions



SOURCE: Higher Education Surveys, Survey on Undergraduate Education in Physics (HES 15), National Science Foundation, 1992 (survey conducted in 1991).

APPENDIX C
Survey Questionnaire

Higher Education Surveys

OMB 3145-0009
Exp. 6/30/91

SURVEY ON UNDERGRADUATE EDUCATION IN PHYSICS

March 1991

Dear Colleague:

On behalf of the National Science Foundation (NSF), we would like to invite you to participate in this Higher Education Survey of undergraduate physics departments. This survey is the first in a series of Higher Education Surveys of selected science and engineering departments, which will capture information on undergraduate science and engineering in the Nation's universities, four-year and two-year colleges.

The National Science Foundation is now actively involved in programs to promote improvements in the quality of undergraduate education in science and engineering. In order to effect these improvements, national data on a wide variety of topics in this critical area are needed. The data developed in this survey will provide up-to-date information to planners and policy makers in education, government, and industry for decision-making which is so critical to the strength of the Nation and to us all.

This survey represents NSF's first effort to gather information, nationally, on a number of important topics in undergraduate science and engineering education. Your participation in the survey, while voluntary, is vital to the development of a national picture of undergraduate science and engineering.

The survey is being conducted for NSF as part of the Higher Education Surveys (HES) system. The data are being collected by the HES contractor, Westat, Inc., located in Rockville, Maryland. A copy of the report, summarizing the results of the survey, will be sent to your institution after this study is completed. If you have any questions about this survey, please call Dr. Laurie Lewis at Westat's toll-free number, 800-937-8281.

Thank you very much for your assistance. We look forward to your helping us with this important project.

Sincerely,

Robert F. Watson, Ph.D.
Director, Division of Undergraduate Science,
Engineering, and Mathematics Education
National Science Foundation

Marcel Bardon, Ph.D.
Director
Division of Physics
National Science Foundation

Sponsored by the National Science Foundation, the National Endowment for the Humanities, and the Department of Education

HIGHER EDUCATION SURVEYS (HES)
SURVEY ON UNDERGRADUATE EDUCATION IN PHYSICS

To the Chair of the Department of Physics, or the department that offers a program in physics.

DEFINITION: Physics includes all courses listed in your college catalog that are part of your undergraduate physics program. For example, if astronomy courses are part of your undergraduate physics program, they should be included in physics. If they are not part of your undergraduate physics program, astronomy should not be included in physics.

I. Department Organization

1a. Does your department have a separate program for any disciplines in addition to physics (e.g., a separate program in astronomy or atmospheric science)?

☐ Yes (GO TO QUESTION 1b)
☐ No (GO TO TOP OF PAGE 2)

1b. **IF YES TO Q1a**: For each discipline besides physics for which your department has a separate program, list the discipline, and indicate whether your department offers undergraduate courses, confers bachelor's degrees, or confers graduate degrees in that discipline. (Do not include interdisciplinary programs and institutes.)

Discipline	Offers undergraduate courses		Confers bachelor's degrees		Confers graduate degrees	
	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No

For all questions that follow, please provide information only for physics as defined in the box at the top of the questionnaire. If it is not possible to separate information for physics from the programs for the other disciplines offered by your department (i.e., those disciplines listed in Question 1b), please report information for your entire department as necessary, and indicate how you have responded for sections II, V, VI, and VII.

2. For each of the following types of degrees, indicate by circling "yes" or "no" in **Column A** whether your department confers that degree in physics.

   For each type of physics degree conferred, indicate in **Column B** the number of physics degrees conferred through your department in academic year 1989-90 (September 1989 through August 1990). If no physics degrees of that type were awarded in academic year 1989-90, enter zero.

Type of degree	**A.** Does department confer physics degrees of this type?	**B.** Number of physics degrees conferred through department in academic year 1989-90
a. Associate	Yes No	
b. Bachelor's	Yes No	
c. Master's	Yes No	
d. Doctorate	Yes No	

3. On which calendar system does your school operate? (CHECK ONE)

   ☐ Semester
   ☐ Quarter
   ☐ Other (PLEASE SPECIFY: _____)

II. Undergraduate Education - Issues and Concerns

The responses to **Q4** are for: (CHECK ONE)

- ☐ Physics only
- ☐ Physics plus the other disciplines (listed in Question 1b) offered by this department

4. In **Column A**, please rate on a scale from 1 to 5 (with 1 = very poor to 5 = very good) the following aspects of undergraduate physics education in your department. If the item is not applicable to your department (e.g., you do not have teaching assistants), circle a zero (0) for that item.

   In **Column B**, rank up to 5 items that present the greatest problems for undergraduate physics education in your department, and write the rank, with "1" indicating the greatest problem, "2" indicating the second greatest problem, etc. If there are no problems in your department, check here ☐, and skip Column B.

Aspects of undergraduate education in physics	A. (Circle one for each item) Not applicable 0	Very poor 1	2	3	4	Very good 5	B. Rank up to 5 problems (from this page)
a. Students							
1. Academic preparation of entering freshmen	0	1	2	3	4	5	_____
2. Student interest and motivation	0	1	2	3	4	5	_____
3. Computer background of students	0	1	2	3	4	5	_____
b. Curriculum							
1. Quality of introductory textbooks	0	1	2	3	4	5	_____
2. Quality of advanced textbooks	0	1	2	3	4	5	_____
3. Opportunity for undergraduate research through independent study or advanced coursework	0	1	2	3	4	5	_____
c. Laboratory equipment for undergraduate instruction							
1. Quality of instructional laboratory equipment	0	1	2	3	4	5	_____
2. Amount of instructional laboratory equipment	0	1	2	3	4	5	_____
d. Facilities for undergraduate instruction							
1. Quality of instructional laboratory space	0	1	2	3	4	5	_____
2. Amount of instructional laboratory space	0	1	2	3	4	5	_____
3. Demonstration capabilities of lecture facilities	0	1	2	3	4	5	_____
e. Faculty/staff resources							
1. Appropriateness of class size for introductory courses	0	1	2	3	4	5	_____
2. Appropriateness of class size for advanced courses	0	1	2	3	4	5	_____
3. Recruiting and retention of qualified faculty	0	1	2	3	4	5	_____
4. Language abilities of faculty members whose first language is not English	0	1	2	3	4	5	_____
f. Teaching assistants (include both graduate and undergraduate T.A.s if applicable)							
1. Availability of teaching assistants	0	1	2	3	4	5	_____
2. Quality of teaching assistants	0	1	2	3	4	5	_____
3. Language abilities of teaching assistants whose first language is not English	0	1	2	3	4	5	_____
g. Other (please specify below)							
1. Other_____	0	1	2	3	4	5	_____
2. Other_____	0	1	2	3	4	5	_____

III. Computer Resources

5. Is there computer equipment located within your department to which undergraduate students have access for undergraduate research and coursework? Do not include terminals linked to the campus-wide computer facility.

☐ Yes
☐ No (SKIP COLUMN A OF QUESTION 7)

6. Is there campus-wide computer equipment at your institution to which undergraduate students have access for undergraduate research and coursework?

☐ Yes
☐ No (SKIP COLUMN B OF QUESTION 7)

7. Please rate on a scale from 1 to 5 (with 1 = very poor to 5 = very good) the following aspects of the computer resources available to undergraduate students at your institution for undergraduate research and coursework.

In **Column A**, rate the computer resources located within your department to which undergraduate students have access for undergraduate research and coursework. If your department does not have such computer equipment, circle zero (0). Do not include terminals linked to the campus-wide computer facility.

In **Column B**, rate the campus-wide computer resources at your institution to which undergraduate students have access for undergraduate research and coursework. If your institution does not have such campus-wide computer equipment, circle zero (0).

Computer resources for undergraduates	A. Departmental resources (Circle one for each item)						B. Campus-wide resources (Circle one for each item)					
	Not applicable 0	Very poor 1	2	3	4	Very good 5	Not applicable 0	Very poor 1	2	3	4	Very good 5
1. Quality of computer equipment.....	0	1	2	3	4	5	0	1	2	3	4	5
2. Amount of computer equipment...	0	1	2	3	4	5	0	1	2	3	4	5
3. Quality of space for computer use.	0	1	2	3	4	5	0	1	2	3	4	5
4. Amount of space for computer use	0	1	2	3	4	5	0	1	2	3	4	5
5. Quality of software for undergraduate instruction.....	0	1	2	3	4	5	0	1	2	3	4	5
6. Quality of software for undergraduate research	0	1	2	3	4	5	0	1	2	3	4	5
7. Other (please specify below) a. Other_____	0	1	2	3	4	5	0,	1	2	3	4	5
b. Other_____	0	1	2	3	4	5	0	1	2	3	4	5

IV. Academic Majors

If this department does not confer bachelor's degrees in physics, check here ☐ and skip to Question 11.

8. By what point in their undergraduate academic career do students majoring in physics have to formally declare a major? (CHECK ONE)

- ☐ At the time of application for admission to your institution
- ☐ By the end of the first academic year
- ☐ By the end of the second academic year
- ☐ By the end of the third academic year
- ☐ Other (PLEASE SPECIFY:_____)

9. Over the last 5 years, has the number of students who declared a major in physics at your institution: (CHECK ONE)

- ☐ Increased
- ☐ Stayed about the same
- ☐ Decreased

10. In your opinion, what are the most important reasons that college students who are interested in majoring in physics decide not to major in physics?

_____

_____

_____

_____

_____

11. What is the single most important thing the National Science Foundation (NSF) can do to improve undergraduate education in physics?

_____

_____

_____

_____

_____

V. Undergraduate Course Offerings

The responses to **Q12** are for: (CHECK ONE)

- ☐ Physics only
- ☐ Physics plus the other disciplines (listed in Question 1b) offered by this department

12. In Fall 1990, how many <u>different</u> undergraduate and graduate physics courses, as identified by course title or number, were taught in your department?

Number of courses: Provide the number of separate, for-credit courses (as identified by course title or number), <u>not</u> the number of sections.

Lower division courses: For-credit courses designed for undergraduates in the first two years of a four-year curriculum.

Upper division courses: For-credit courses designed for undergraduates during the third and fourth years of a four-year curriculum.

Joint level courses: If a course is a joint undergraduate and graduate level course, count it as an undergraduate level course.

(a) Total graduate and undergraduate physics courses (<u>not</u> sections) _____

(b) Total <u>graduate</u> physics courses (<u>not</u> sections) _____

(c) Total <u>undergraduate</u> physics courses (<u>not</u> sections) _____

(d) Lower division physics courses _____

(e) Upper division physics courses _____

(Check here if you cannot provide separate figures for lower and upper division physics courses ☐)

NOTE: The total graduate courses (b) plus the total undergraduate courses (c) should equal the total courses (a). The total lower division courses (d) plus the total upper division courses (e) should equal the total undergraduate courses (c).

VI. Instructional Staff

The responses to **Q13-Q16** are for: (CHECK ONE)
- ☐ Physics only
- ☐ Physics plus the other disciplines (listed in Question 1b) offered by this department

13. In each category of instructional staff below, in **Column 1** indicate the total number of people who taught at least one physics course in your department in Fall 1990, and in **Column 2** indicate the number who taught at least one physics course to undergraduates in Fall 1990.

- Consider a teacher full-time if he/she had full-time teaching/research/administrative responsibilities within your institution in Fall 1990.
- Count visiting faculty under the rank they have at their home institutions.
- Exclude members of your faculty who were on leave in Fall 1990.
- For teaching assistants, include both graduate and undergraduate students who are teaching assistants, if applicable.

Instructional staff	Physics teachers in Fall 1990	
	1. Total number teaching physics	2. Number who taught physics to **undergraduates**
a. Full-time faculty, total		
1. Full professor		
2. Associate professor		
3. Assistant professor		
4. Lecturer or instructor		
5. Unranked		
b. Part-time faculty, total		
c. Teaching assistants, total		
d. Other (please specify):		

14. In Fall 1990, what percent of the total undergraduate instructional contact hours (lecture, laboratory, discussion group) in your department was taught by full-time faculty, part-time faculty, teaching assistants, and other kinds of instructors?

Instructional staff	Percent
a. Full-time faculty	%
b. Part-time faculty	%
c. Teaching assistants	%
d. Other (please specify:)	%
TOTAL	100%

15. For those full-time and part-time faculty who taught physics to undergraduates in Fall 1990 (question 13, column 2, rows a and b), please indicate their highest degree.

Highest degree	Number who taught physics to undergraduates	
	Full-time faculty	Part-time faculty
Doctorate		
Master's		
Bachelor's		
Other (please specify):		

TOTAL: ☐ (should equal Q13, column 2, row a) ☐ (should equal Q13 column 2, row b)

16. For those full-time and part-time faculty who taught physics to undergraduates in Fall 1990 (question 13, column 2, rows a and b), please indicate their racial/ethnic group and gender.

Racial/ethnic group (see definitions below)	Full-time		Part-time	
	Men	Women	Men	Women
Non-resident aliens				
U.S. citizens and permanent residents: Black, non-Hispanic				
White, non-Hispanic				
Hispanic				
Asian or Pacific Islander				
American Indian or Alaskan Native				

TOTAL: ☐ (should equal Q13, column 2, row a) ☐ (should equal Q13, column 2, row b)

Racial/ethnic group

Non-resident alien: A person who is not a citizen of the United States and who is in this country on a temporary basis and does not have the right to remain indefinitely.

Black, non-Hispanic: A person having origins in any of the black racial groups in Africa, excluding persons of Hispanic origins.

White, non-Hispanic: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East, excluding persons of Hispanic origins.

Hispanic: A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

Asian or Pacific Islander: A person having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands. This area includes, for example, China, India, Japan, Korea, the Philippine Islands, and Samoa.

American Indian or Alaskan Native: A person having origins in any of the original peoples of North America and maintaining cultural identification through tribal affiliation or community recognition.

VII. Teaching Assistants

If there were no teaching assistants in your department in Fall 1990, check here ☐ and skip to the next page.

The responses to **Q17-Q22** are for: (CHECK ONE)
- ☐ Physics only
- ☐ Physics plus the other disciplines (listed in Question 1b) offered by this department

17. Please indicate below the percent of teaching assistants in your department in Fall 1990 who are graduate students and undergraduate students. Enter zero (0) if there were no teaching assistants of that type in Fall 1990.

a. Teaching assistants who are graduate students: _____%

b. Teaching assistants who are undergraduate students: _____%

TOTAL 100%

18. Do the teaching assistants in your department:

a.	Lecture on a regular basis?	☐ Yes	☐ No
b.	Lecture occasionally?	☐ Yes	☐ No
c.	Conduct laboratory sections?	☐ Yes	☐ No
d.	Conduct discussion groups?	☐ Yes	☐ No
e.	Grade tests and papers?	☐ Yes	☐ No
f.	Hold office hours?	☐ Yes	☐ No

19. How many laboratory sections and/or discussion groups does a teaching assistant in your department usually lead in a term (semester, quarter, etc.)? _____

20. Does your institution or department offer a course or seminar to enhance the teaching and communication skills of teaching assistants in your department?

- ☐ Yes (ANSWER QUESTIONS 21 AND 22)
- ☐ No (SKIP QUESTIONS 21 AND 22)

21. What is the content of this course or seminar? (CHECK ALL THAT APPLY)

- ☐ Teaching techniques
- ☐ Preparation of course materials
- ☐ Techniques for student academic or career advising
- ☐ English language skills
- ☐ Familiarization with American customs and behaviors
- ☐ Other (PLEASE SPECIFY: _____)

22. Are all teaching assistants in your department required to take this course or seminar? (CHECK ONE)

- ☐ All teaching assistants are required to attend
- ☐ Only some teaching assistants are required to attend
- ☐ No teaching assistants are required to attend

Do we have permission to release these data to the National Science Foundation with your institutional identification code? This would allow NSF to use data from other surveys to help analyze the results. All information published by NSF will be in aggregate form only.

☐ Yes
☐ No

Please sign_____

Thank you for your assistance. Please return this form by March 22 to:

Higher Education Surveys
WESTAT
1650 Research Boulevard
Rockville, MD 20850

Person completing this form:

Name:_____

Title:_____

Department name:_____

Telephone:_____

Please keep a copy of this survey for your records.

If you have any questions or problems concerning this survey, please call the HES Survey manager at Westat:

Laurie Lewis
(800) 937-8281 (toll-free)